Week 5: SEARCH TECHNIQUES AND STRATEGIES, E.G. ITERATIVE, HEURISTIC SEARCH STRATEGIES, ETC.

SEARCH TECHNIQUES

Search strategy is the action plan which is drawn to conduct a search. It encompasses several steps and levels of work in information retrieval. There are many issues that need to be considered while formulating an appropriate search statement. These are: (i) the concepts or facets to be searched and their order. ii) the term(s) that appropriately represent(s) the search concept. iii) the feature(s) of the retrieval system concerned; and iv) the measures to be taken in revising a search statement.

1. Keyword Searching: Database looks for keywords anywhere in the record (title, author, subject headings, publisher etc.). A good substitute for subject, title or author search when you have their incomplete information.

2. Boolean operators: This search is based on Boolean logic. The following three common Boolean Operators used are: AND, OR and NOT. The operator **AND** narrows the search, retrieves records that include both terms, used for terms or concepts that are not related while **OR** broadens it OR‟ operator ⎪ retrieves records that include either of the terms ⎪ broadens your search ⎪ used for related terms or concept. **NOT** is used for exclusion. It retrieves records that include one term but not another term; eliminates all the records containing the second term ⎪ narrows your search ⎪ may eliminate relevant records.

Other specific search techniques are summarised in the table

Technique	**Description**	**Symbol/Example**	**Purpose**
Phrase Searching	Searches for words that appear immediately next to each other as an exact phrase.	"self-esteem", "climate change"	Increases precision by limiting results to exact phrases.
Boolean Operators	Uses logical operators to combine or exclude search terms.	**AND**, **OR**, **NOT**	Refines/expands the search; AND narrows (requires both terms), OR broadens (requires either term), NOT excludes.

Technique	Description	Symbol/Example	Purpose
Truncation	Uses a symbol (usually an asterisk) to find variant endings of a word stem.	therap* finds therapy, therapist, therapies	Broadens the search to find singular/plural forms and variant word endings.
Wildcards	Uses a symbol to substitute for a single character, often for variant spellings.	behavio?r finds behavior, behaviour	Broadens the search to include different spellings.
Controlled Vocabulary	Uses subject headings or index terms (e.g., MeSH in PubMed) specific to the database.	*See database thesaurus*	Increases recall by capturing relevant articles regardless of the author's exact keywords.
Field Searching	Restricts the search to a specific part of the record (e.g., Title, Abstract, Author, Subject).	title: (vaccine)	Increases precision by finding terms in highly relevant fields.
Citation Searching	Checking the reference lists of relevant articles (backward searching) or using citation databases to see which newer articles have cited a known relevant source (**forward** searching).		Identifies seminal works and newer, related research.

What is a search strategy?

A search strategy is a logical series of steps for planning and preparing an efficient way to collect information on a given topic. A search strategy shows how these terms combine in order to retrieve the best results. Search strategies are methods or techniques used to find information, solve problems, or navigate through a collection of data. They can be applied in various contexts such as information retrieval, problem-solving, research, and even decision-making processes.

Strategies refer to the overall approach or method used to navigate and find solutions, while search techniques are the specific tools, methods, or steps used within those strategies to optimize the search process.

Different databases work in different ways, so you need to adapt your search strategy for each of the databases you use. Developing a good search strategy requires knowledge about the nature and organization of target database (s) and the exact needs of the user. Knowledge of the user's exact requirement can greatly affect the actual search and retrieval process. In some cases, the user may want only a few relevant items on a given topic, in which case the task of searching will obviously be limited. Conversely, the user may wish to obtain all the relevant items (obviously with as small a number of non-relevant items as possible), in which case the search must be exhaustive. Thus, an information search may fall in one of the following three categories:

a) **High recall search:** when the user needs to find out all the relevant items on the stated topic. Recall is a parameter used to measure the performance of information retrieval systems; it is measured as the proportion of relevant items retrieved from a collection in a given search session;

b) **High precision search:** when the user needs only relevant items, i.e., as small a number of non-relevant items as possible. Precision is a parameter used to measure the performance of information retrieval systems; it is measured as the proportion of the retrieved items that are relevant in a given search session; and

c) **Brief search:** when the user wants only a few relevant items as opposed to all the relevant items.

ITERATIVE STRATEGIES is a research strategy that involves repeatedly searching, learning, and revising your search until you are satisfied with the results. It is a practice that involves building, refining, and improving a project, product, or initiative.

This strategy is commonly used in problem-solving, development, and learning where each cycle builds upon the previous one, allowing for adjustments and improvements based on feedback or new information.

Key Characteristics of Iterative Strategies:

1. **Repetition**: The process is repeated multiple times, with each cycle being similar to the previous one but with incremental improvements.
2. **Refinement**: After each iteration, the solution or output is refined based on feedback, results, or analysis from the previous iteration.

3. **Feedback-Driven**: Adjustments or changes are made based on feedback or observations from earlier stages.
4. **Progressive Improvement**: With each iteration, the goal is to enhance or optimize the process, gradually improving the overall outcome.
5. **Flexibility**: Iterative strategies allow for flexibility and adaptability since they encourage learning and modifications at each step.

Examples of Iterative strategies

Iterative Learning:

- In learning or education, an iterative approach encourages learners to revisit concepts and improve understanding over time, based on feedback and practice. Example: In language learning, a student might practice vocabulary and grammar, receive feedback from an instructor, and then apply that feedback in the next set of exercises, refining their skills with each iteration.

Iterative Design in Product Development:

- Product development often involves an iterative cycle of designing, testing, and improving. Products are released in stages, with each iteration introducing enhancements based on user feedback. Example: A car manufacturer may release a model with basic features, then release updated models every year, incorporating changes based on customer feedback and technological advancements.

Benefits of Iterative Strategies:

1. **Improved Outcomes:** Iterative approaches help refine and improve results with each cycle, often leading to better solutions.
2. **Flexibility:** Changes can be made at each iteration, which allows for greater adaptability to new information, requirements, or feedback.
3. **Reduced Risk:** By working in small steps and making adjustments along the way, there is less risk of committing to a final solution that doesn't meet needs or expectations.
4. **Continuous Improvement:** Each iteration provides an opportunity to learn from past experiences and make incremental improvements.
5. **Faster Problem Resolution:** Iteration allows teams or individuals to identify problems and correct them early in the process rather than waiting until the end.

HEURISTIC SEARCH STRATEGIES refer to problem-solving methods that use practical, often simplified, approaches or rules of thumb (called heuristics) to find solutions more quickly when finding an optimal solution is too time-consuming or computationally expensive. These strategies do not guarantee the best solution, but they often provide a good enough solution within a reasonable amount of time. Heuristic is a method involving adapting the approach to a problem based on previous solutions to similar problems. These approaches aim to be eas and quickly applicable to a range of problems, so as to find approximate solutions quickly without using the time and resources to develop and execute a precise approach. The principle of heuristics can be applied to various problems in mathematics, science and optimsation by applying heuristics computationally.

Heuristic search is also a type of algorithm that is used to find the best solution to a problem by using a heuristic, or rule of thumb. The ability to process information quickly and efficiently is a key factor in the success of many modern algorithms. Heuristic search has been used for centuries as an effective tool for finding solutions to complex problems. It involves applying principles from mathematics, computer science, and artificial intelligence to find optimal or near-optimal solutions for particular types of problems.

Heuristics are rules of thumb that can be used to make decisions and solve problems. They are often based on experience or intuition rather than scientific methods. By leveraging these simple but powerful concepts, heuristic searches can seek out potential answers faster than traditional approaches such as brute force searching or exhaustive enumeration. In addition, they give more control over what type of solution is desired since they allow users to define parameters and preferences to guide the search towards specific outcomes.

Heuristic search also provides an efficient way to explore large problem spaces with limited resources. Its flexibility allows it to handle different kinds of tasks including optimisation, game playing, scheduling, routing, planning, constraint satisfaction problems, and others. With these advantages combined with its low computational complexity compared to alternative approaches like AI techniques, heuristic search has become a popular choice among researchers looking for new ways to tackle difficult challenges. Heuristic search is widely used in areas like artificial intelligence, optimization problems, and pathfinding.

Key Characteristics of Heuristic Search Strategies:

1. **Approximate Solutions**: Heuristics are designed to find good enough or near-optimal solutions in a reasonable amount of time.
2. **Informed Search**: Heuristic searches use extra information (beyond just the problem itself) to guide the search toward promising areas of the search space.
3. **Speed and Efficiency**: By using heuristics, these strategies often reduce the time and computational resources required compared to exhaustive search methods.
4. **Greedy Approach**: Many heuristic strategies use a "greedy" approach, where the next move is chosen based on a rule that seems the best at the moment.

Advantages of Heuristic Search Strategies:

1. **Efficiency**: Heuristic search methods can find solutions faster than exhaustive methods like brute-force search, especially for large problem spaces.
2. **Scalability**: Many heuristic algorithms are more scalable, handling larger datasets or more complex problems.
3. **Practical Solutions**: While they might not always guarantee the best solution, they can often provide a solution that is good enough within reasonable time frames.
4. **Flexibility**: Heuristic search strategies can be adapted to a wide range of problems with different search spaces and constraints.